

# WEBINARS 2017

### Model Based Requirements Engineering (MBRE)

Tuesday, 06 February 2018

# TRCWEBINARS 2017

### Introduction: Webinar rules

- > Webinar rules:
  - > The Webinar will start in few minutes
  - > You'll be muted all along the Webinar
  - > There's a chatting box to ask your questions or send your comments when you want
  - > Please address these comments and questions to the user "The REUSE Company" and not to me directly
  - > If you have any technical issue please use this chatting box, or mail us at: <a href="mailto:support@reusecompany.com">support@reusecompany.com</a>
  - > The Webinar will be recorded. A link to the recording will be sent to you in few days



#### Presenter's profile

- CTO at The REUSE Company
- SE Professor at Universidad Carlos III de Madrid (Spain)
- President Elect of AEIS (INCOSE Spain)

- Member of AEIS Board
- INCOSE Ontology Working Group Chair
- Member of INCOSE Requirements Engineering WG
- Contributor to INCOSE Guide for Writing Requirements
- Certified Systems Engineering Professional (CSEP)



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- Description of The Reuse Company
- > Whishes Upon a Star
- > MBSE Introduction
- Model Based Requirements Engineering
- Demos and Conclusion





The REUSE Company in the World







### Selected set of Customers

Aerospace and Defense

AIRBUS AIRBUS HELICOPTERS	EADS INNOVATION WORKS		SAFRAN Snecma SAFRAN Sagem
Automotive	Energy	Consulting	
	FUSION FOR ENERGY the way	to new energy	
Banking		Health care	
Banco de Costa Rica	\delta Santander		Health Net
Other industries			
sage	SIEN	IENS	tirant editorial



### KCSE Suite v18



Global Quality Management

#### SIM –System Interoperability Manager

Tailorable Interoperability Platform

- R+ Manager

Managing requirements transformations Managing models transformations

- T+ Manager

Managing traceability

- Reasoning Manager
  - Task based environment



### Whishes upon a Star

#### Possible Use Cases involving Requirements and MBSE



Use Case I – Requirements meet Models

### Performing Requirements Engineering BUT as part of MBSE processes

- You need to develop requirements but you know they are affected by existing models
- You know that requirements evolution and management will also affect the models
- > We'd like to perform modern Requirements engineering within Models development
- > But we'd also like to see requirements as humans like to see them (grouped within a story thread)

Could I dream with automatically tracing the models (and their elements) with the requirements when they are really dependent on each other?



### Use Case 2 – Smart Authoring

Electrical

System Level

Devic

### Simulating Requirements + Models during the Authoring process

- Would you like to "execute" a requirement by running a FMU, from inside a RMS or a Modelling tool?
  - Using information from the requirement + Models
  - Checking validity of the requirement or the model running an simulation of a Physical model
  - Getting VALID / NOT VALID information on the fly
  - Updating information of the requirement or model, gathered from the Simulation Execution



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### Use Case 3 – Requirements Initiate Models

### A requirements specification produces and maintains Models during its development

- > You have struggled to produce a good requirements specification.
  - Why shouldn't you automatically produce Models out of them?
  - Perhaps physical Models in Modelica?
- > Could I do it the other way around?
  - Generate Requirements from my very mature models
- Could I dream with automatically tracing the models (and their elements) with the originating requirements on the fly?
- Could I dream with managing changes in both sides?





### Automatic generation of Test Cases from requirements texts

- > You have struggled to produce a good requirements specification.
- > Why shouldn't you automatically produce Test Cases?
  - > Perhaps scripts that can run on Simulink?
  - > Or Test sequences in English?
- > Should it be interesting to automatically translate the test cases to Spanish?
  - > Without loosing a single semantic aspect
  - > To allow us the development and implement of the tests directly in Spain
- > Why shouldn't we also generate lower level requirements from the initial requirements set?
- > Could I dream in automatically tracing these operations within a traceability system?



### Model Based Systems Engineering

In a nutshell



### Model Based Systems Engineering (MBSE)

\* "The formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases."

INCOSE SE Vision 2020 (INCOSE-TP-2004-004-02 September, 2007)

- Models as part of the flow information among activities and processes
- Eases traceability possibilities
- Enable computers to operate (transformations, simulations, V&V aids)



### MBSE – From Document Centric...

#### Stand-alone models related through documents. Documents are part of configuration management systems.

INCOSE MBSE Workshop, Jan 2014



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### ... Towards Model Based

MBSE: Shared system model with multiple views and connected to discipline models. Reusable model-based engineering with virtual product development and simulation capability

INCOSE MBSE Workshop, Jan 2014



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### We don't want to forget Requirements





### Model Based Requirements Engineering

Kernel concepts

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#### I- Universal Access to Everything



Mats Berglund (Ericsson) http://www.ices.kth.se/upload/events/13/84404189f85d41a6a7d1cafd0db4ee80.pdf

- Multiple **domains** 
  - Different types of artifacts

- Need of intra-operability
  - Intra-domain
- Need of interoperability
  - Inter-domain



I- Universal Access to Everything

#### UNIVERSAL ACCESS to everything





### 2- Knowledge must be shared





3- Common representation for everything

OpAm

XX

Condensator

ZZ

<<>YY>>

#### COMMON representation for everything



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### Knowledge Centric Systems Engineering (KCSE)





### Model Based Requirements Engineering

Formalizing natural language Requirements (and Models)



### Formalization of Requirements Statements

- Necessary IT solutions that attempt to represent and formalize Requirements as Conceptual Graphs
- > Using Ontologies and Requirements Patterns





### **Requirements Formalization Ontology**

A380 A350 System Operate Temperature Environment Pressure Shall a minimum Of   At Work °C
Thesaurus < <operation>&gt; &lt;<aircraft>&gt; Environment " Greater than (&gt;) "   a minimum Operate Work A380 A350 Temperature Pressure</aircraft></operation>
Patterns/ Models Coperation At Coperation Environment Of NUMBER [MEASUREMENT UNIT]
Generation Rules
Inference Rules If NUMBER "Lower than (<) " -60° °C    NUMBER "Greater than (>) " +60° °C ->
Applications
The aircraft shall operate at a minimum temperature of -70° C $\overline{\text{Temperature}}$
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#### Formalization of system Models





### Model Based Requirements Engineering

**Text Generation** 

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### **Textual Generation Transformations**

- Textual Generation uses mapping between patterns, which identify the original work-product and the automatically generated work-product.
- > Using patterns we make sure that the exit work-product is formed as we wish.



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### Bring requirements to MBSE







### Use Case Demos



Use Case I – Requirements meet Models

### Performing Requirements Engineering BUT as part of MBSE processes

> Demo Scenario





CREATING / EDITING REQUIREMENTS INSIDE RHAPSODY



EDITING REQUIREMENTS USING FORMAL PATTERNS



MANAGING REQUIREMENTS AS A RMS



GENERATING MODELS FROM REQUIREMENTS IN DOORS



on the fly

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SIMULATING REQUIREMENTS USING MODELS AND FMUs

Simulating Requirements + Models during the Authoring process

Radar

The



- model Getting VALID / NOT VALID information
- **Models** Checking validity of the requirement or the > model running an simulation of a Physical
- Modelling tool? Using information from the requirement +
- by running a FMU, from inside a RMS or a
- Would you like to "execute" a requirement



### Use Case 2 – Smart Authoring

Devic



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### Use Case 3 – Requirements Initiate Models

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#### Automatic generation of Test Cases from requirements texts





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> Demo Scenario





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AUTOMATIC GENERATION OF TEST CASES FROM REQS



AUTOMATIC TRANSLATION OF TEST CASES



AUTOMATIC ANONYMIZATION OF REQUIREMENTS



OMATIC REQUIREMENTS TRANSLATION ROUND TRIP



Use Case 5 – Traceability

Automatic traceability discovery between requirements and Models

- > A team in your organization has developed a good requirements specification.
- > Other team in your organization has developed a good Models design.
- > But no traceability work was defined neither performed
- > Would you like a system to offer suggested traceability between Requirements and Models?





### **Traceability Between Requirements and Models**

- Every 4 seconds, the power control system shall send a "demand battery load level" message to the battery

- When the voltage level is below 11,5V, the battery shall send a "low battery load level" message to the power control system.
- If the battery is low, the power control system shall send a "show low energy level alarm" signal to the information display system
- The user must plug in the bicycle to the electrical power

- When the bicycle is charging, the power control system shall send a "Load battery" signal to the charge system.

- When the battery is loaded, the charge system shall send a "stop charge system Loading" message to the Power control system



- > Total number of Matches = 5
- Number of Requirements with no match in the model = 1
- Number of transitions in the model with no match in requirements = 6

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### Traceability Between Requirements and Models





#### Conclusions

- > Requirements engineering can be improved by merging it with MBSE and vice versa
- > Requirements Engineering can be assisted if requirements are automatically managed and formalized
- It becomes possible to generate SE activities and automatically trace work-products
- > Model Based Requirements Engineering is the kernel for better requirements engineering







### Questions?

